CLAIMS

1. A position detector comprising:

first and second members mounted for relative movement along a measuring path;

said first member comprising a magnetic field generator for generating a magnetic field;

said second member comprising first and second conductors which are inductively coupled to said magnetic field generator, the first conductor extending in a geometrically varying manner having a first characteristic dimension along the measuring path and the second conductor extending in a geometrically varying manner having a second different characteristic dimension along the measuring path, as a result of which, in response to a magnetic field generated by said magnetic field generator, a first signal is generated in a first receive circuit which first signal varies in dependence upon the relative position and orientation of the first conductor and the magnetic field generator and a second different signal is generated in a second receive circuit which second signal varies in dependence upon the relative position and orientation of the second conductor and the magnetic field generator; and

means for processing said first and second signals to determine the relative position and orientation of the two movable members using a relationship between the respective characteristic dimension of the geometrical variation of said two conductors.

2. A position detector according to claim 1, wherein said conductors and said magnetic field generator are arranged so that said first and second signals vary substantially sinusoidally with the relative position of the two movable members.

3. A position detector according to claim 2, wherein said relative orientation of said two movable members causes a phase shift in said sinusoidal variations.

4. A position detector according to claim 1, wherein said second member further comprises third and fourth conductors which are inductively coupled to said magnetic field generator, the third conductor extending in a geometrically varying manner having the same characteristic dimension as the first conductor and the fourth conductor extending in a geometrically varying manner having the same characteristic dimension as the second conductor, wherein the first and third conductors are shifted relative to each other along the measuring path, wherein the second and fourth conductors are shifted relative to each other along said measuring path and wherein in response to a magnetic field generated by said magnetic field generator, a third signal is generated in a third receive circuit which third signal varies in dependence upon the relative position and orientation of the third conductor and the magnetic field generator and a fourth signal is generated in a fourth receive circuit which fourth signal varies in dependence upon the relative position and orientation of the fourth conductor and the magnetic field generator.

5. A position detector according to claim 4, wherein said first and third conductors are spaced along said measuring path so as to form a phase quadrature pair.

6. A position detector according to claim 4, wherein said second and fourth conductors are spaced along said measuring path so as to form a phase quadrature pair.

7. A position detector according to claim 1, wherein said processing means is operable to process said first and second signals to provide a first value which depends upon said relative position and orientation and a second different value which depends upon said relative position and orientation.

8. A position detector according to claim 7, wherein said processing means is operable to determine said relative position and orientation by performing a weighted combination of said first and second values and wherein the weighting applied depends upon the characteristic dimension of the geometrical variation of said conductors.

9. A position detector according to claim 1, wherein said conductors are periodic and wherein said characteristic dimension of the respective conductors comprises the pitch.

10. A position detector according to claim 1, wherein said conductors are tapered, narrowing in from their ends towards a central cross-over point to define a number of substantially triangular shaped loops, and wherein said characteristic dimension comprises the taper of each of the said conductors.

11. A position detector according to claim 1, wherein said processing means is arranged to process said first and second signals to provide (i) a coarse measurement value indicative of the relative position of said two movable members which is independent of the relative orientation of said two movable members; and (ii) a fine measurement value indicative of the relative position of said two movable members which is dependent

upon the relative orientation of said two movable members.

12. A position detector according to claim 11, wherein said relative orientation causes an apparent shift in the fine measurement value relative to the coarse measurement value.

13. A position detector according to claim 12, wherein said shift is approximately twice the angle of the relative tilt between the two movable members along the measuring path.

14. A position detector according to claim 12, wherein said angle of tilt is known and used to determine the relative position of said members from said fine measurement value.

15. A position detector according to claim 1, wherein said magnetic field generator comprises a powered coil.

16. A position detector according to claim 1, wherein said magnetic field generator comprises at least one of: a resonator, a short circuit coil and a conductive screen.

17. A position detector according to claim 16, wherein said magnetic field generator comprises an inductor and capacitor resonant circuit.

18. A position detector according to claim 16, wherein said magnetic field generator comprises a ceramic resonator.

19. A position detector according to claim 16, wherein said second member further comprises an excitation circuit for energising said magnetic field generator.

20. A position detector according to claim 19, wherein said excitation circuit is arranged to have a substantially constant coupling with said magnetic field generator over the measurement path.

21. A position detector according to claim 20, wherein said first receive circuit comprises said first conductor and wherein said second receive circuit comprises said second conductor.

22. A position detector according to claim 21, wherein said third receive circuit comprises said third conductor and wherein said fourth receive circuit comprises said fourth conductor, and wherein said processing means is operable to combine the signals from said first and third receive circuits and to combine the signals from said second and fourth receive circuits in order to derive said position and orientation information.

23. A position detector according to claim 22, wherein each of said receive signals varies sinusoidally with said relative position along the measuring path and wherein the peak amplitude of said sinusoidal variation varies in dependence upon the gap between said magnetic field generator and said conductors, and wherein said processing means is operable to combine the signals from the first and third receive circuits and/or to combine the signals from the second and fourth receive circuits to determine an indication of the gap between said first and second members.

24. A position detector according to claim 22, wherein said processing means is operable to extract said positional information by determining a ratiometric arc-tangent of measurements derived from the signals receive in said first and third receive circuits and of measurements derived from the signals received in said second and fourth receive circuits.

25. A position detector according to claim 24, wherein said processing means is operable to combine the positional information extracted from the signals from said first and third receive circuits and the positional information extracted from said signals from the second and fourth receive circuits, to provide a coarse position measurement value which does not depend upon the orientation of said two moveable members, and to provide a fine measurement value which does depend upon said relative orientation.

26. A position detector according to claim 19, wherein said excitation circuit comprises one of said first and second conductors.

27. A position detector according to claim 26, when dependent upon claim 4, wherein said excitation circuit comprises said first and third conductors and wherein said first receive circuit comprises said second conductor and said second receive circuit comprises said fourth conductor.

28. A position detector according to claim 19, further comprising a drive means for applying an energising signal to said excitation circuit.

29. A position detector according to claim 28, wherein said drive means is operable to energise both said first and third conductors and wherein said processing means is operable to process the signals received from said second and fourth conductors as a result of the excitation of said first and third conductors.

30. A position detector according to claim 29, wherein said processing means is operable to combine the signal received in said second conductor when said first conductor is energised with the signal received in said fourth conductor when said third conductor is energised and to combine the signal received in said fourth conductor when said first conductor is energised with the signal received in said second conductor when said third conductor is energised.

31. A position detector according to claim 30, wherein said combination includes obtaining the sum and difference of said signals.

32. A position detector according to claim 30, wherein said processing means is operable to extract positional information from said combined signals by determining a ratiometric arc-tangent of the combined signals to provide a coarse position measurement value which does not depend upon the orientation of said two moveable members, and to provide a fine position measurement value which does depend upon said relative orientation.

33. A position detector according to claim 28, wherein said drive means is operable to apply a pulse of said energising signal to said excitation circuit during a first time interval and wherein said processing means is operable to process said induced signals during a

subsequent second time interval after said first time interval.

34. A position detector according to claim 1, wherein said conductors are arranged to form at least two loops arranged in succession along said measuring path, each loop extending along said path and said loops being connected in series and being arranged so that EMFs induced in adjacent said loops by a common background alternating magnetic field oppose each other.

35. A position detector according to claim 34, wherein said loops have a generally rectangular shape.

36. A position detector according to claim 34, wherein said loops have a generally hexagonal shape.

37. A position detector according to claim 34, wherein each loop comprises one or more turns of conductor.

38. A position detector according to claim 1, wherein said first and second signals are time varying signals whose amplitude varies in dependence upon said relative position and orientation of the two moveable members.

39. A position detector according to claim 38, wherein said processing means comprises a demodulator for demodulating the received signals.

40. A position detector according to claim 1, wherein said conductors are formed by wires bonded onto one or more substrates.

41. A position detector according to claim 1, wherein said first and second conductors are formed substantially

in the same plane or in substantially parallel planes.

42. A position detector according to claim 1, wherein said second member is fixed and said first member is moveable.

43. A position detector according to claim 1, arranged to detect the relative position and orientation of a plurality of first members, each having a respective magnetic field generator characteristic of the first member.

44. A two dimensional position detector comprising:

first and second members mounted for relative movement in first and second directions in a measuring plane;

a first position detector according to claim 1 for detecting the relative position and orientation of the first and second members in the first direction;

a second position detector according to claim 1 for detecting the relative position and orientation of said first and second members in said second direction; and

means for combining the relative orientations in said first and second directions to determine the relative orientation of said first and second members in said measuring plane.

45. A position detector according to claim 44, wherein said first member comprises first and second magnetic field generators which are operable to generate respective different magnetic fields in substantially different directions, and wherein said processing means is operable to distinguish the signals from the two magnetic field generators to determine said relative position and orientation in said plane.

46. A position detector according to claim 45, wherein the first magnetic field generator is operable to produce a magnetic field substantially in a direction perpendicular to said plane, and wherein said processing means is operable to process the signals received from the first magnetic field generator to determine a fine and a coarse position measurement of the relative position of said first and second members, and wherein said second magnetic field generator is operable to generate a magnetic field substantially in a direction which is inclined at a predetermined angle to said plane, and wherein said processing means is operable to process the signals from said second magnetic field generator to determine the relative orientation of said first and second members in said plane.

47. A position detector according to claim 46, wherein said first and second magnetic field generators are coincident with each other.

48. A position detector according to claim 45, wherein said first and second magnetic field generators are separated from each other by a predetermined distance, and wherein said processing means is operable to process the signals received from said first and second magnetic field generators to determine the complete relative orientation of said first and second members.

49. A position detector according to claim 45, comprising three coincident magnetic field generators each arranged to generate a magnetic field in different directions and arranged such that said processing means can process the signals received from said magnetic field generators and derive the complete relative orientation of said first and second members.

50. A position detector according to claim 44, wherein said magnetic field generators comprise a powered coil and/or a resonator.

51. A position detector according to claim 50, wherein each of said magnetic field generators comprises an inductor and a capacitor resonant circuit.

52. A position detector according to claim 44, wherein the windings used in the two different directions have substantially the same form.

53. A resonator combination for use in a position detector according to claim 1, the resonator combination comprising first and second different resonators each comprising an inductive coil and a capacitor, the combination being such that the centre point of each resonator coil is the same and so that the axis of said coils are inclined relative to each other.

54. A resonator combination according to claim 53, further comprising a third resonator comprising an inductive coil and a capacitor, wherein the centre point of the third resonator coil coincides with the centre point of the coils of the other two resonators wherein the axis of the third resonator coil is tilted to the axis of the other two resonator coils so as to allow said position detector to determine the complete orientation of an object carrying said resonator combination from the signals induced in receive windings forming part of the position detector from the signals induced in said receive windings by the three different resonators.

55. A position detector comprising:

first and second members mounted for relative movement along a measuring path;

said first member comprising a magnetic field generator for generating a magnetic field;

said second member comprising first and second conductors which are inductively coupled to said magnetic field generator, the magnetic coupling between said first conductor and said magnetic field generator varying with a first spatial frequency and the magnetic coupling between said second conductor and said magnetic field generator varying with a second different spatial frequency, as a result of which, in response to a magnetic field generated by said magnetic field generator, a first signal is generated in a first receive circuit which first signal varies in dependent upon the relative position and orientation of the first conductor and the magnetic field generator and a second different signal is generated in a second receive circuit which second signal varies in dependence upon the relative position and orientation of the second conductor and the magnetic field generator; and

means for processing said first and second signals to determine the relative position and orientation of the two moveable members in dependence upon said first and second spatial frequencies.

56. A position detector comprising:

first and second members mounted for relative movement in a measuring plane;

said first member comprising a magnetic field generator for generating a magnetic field;

said second member comprising first and second groups of circuits for sensing the relative position and orientation of the first and second members in two different directions in said plane; and

means for determining the relative orientation of the first and second members in said plane using the relative orientations in said first and second directions;

characterised in that each group of windings comprises first and second conductors which are inductively coupled to said magnetic field generator, the first conductor extending in a geometrically varying manner having a first characteristic dimension along the corresponding direction and the second conductor extending in a geometrically varying manner having a second different characteristic dimension along said corresponding direction.

57. A method of manufacturing a plurality of shaped conductors for use in a position detector according to claim 1, the method comprising the steps of:

winding a wire on a wiring loom in the required manner so that the conductors extend in the measurement path in a geometrically varying manner having the respective characteristic dimension along the measuring path; and

bonding the wires to one or more substrates.

58. A position detector comprising:

first and second members mounted for relative movement along a measuring path;

said first member comprising a magnetic field generator for generating a magnetic field;

said second member comprising first and second circuits each comprising a conductor which is inductively coupled to said magnetic field generator, the conductor of said first circuit extending in a geometrically varying manner having a first characteristic dimension along the measuring path and the conductor of said second

circuit extending in a geometrically varying manner having a second different characteristic dimension along the measuring path, as a result of which, in response to a magnetic field generated by said magnetic field generator, a first signal is generated in said first circuit and a second different signal is generated in said second circuit, the first and second signals both varying in dependence upon the relative position and orientation of the two moveable members; and

means for processing said first and second signals to determine said relative position and orientation a relationship between the respective characteristic dimension of the geometrical variation of said two conductors.

59. A position detector comprising:

first and second members mounted for relative movement along a measuring path;

said first member comprising a magnetic field generator for generating a magnetic field;

said second member comprising first and second periodic windings which extend along the measuring path and which are inductively coupled to said magnetic field generator, the period of said first winding being different to the period of said second winding, as a result of which, in response to a magnetic field generated by said magnetic field generator, a first signal is generated in said first circuit and a second different signal is generated in said second circuit, the first and second signals both varying in a substantially sinusoidal manner in dependence upon the relative position and orientation of the two moveable members;

means for processing said first and second signals to provide a first value which depends upon said relative position and orientation and a second different value

which depends upon said relative position and orientation; and

means for combining said first and second values to determine said relative position and orientation in dependence upon a relationship between the two periods of said windings.

60. A position detector according to claim 59, wherein said combining means comprises sum and difference means for determining the sum and difference of said first and second values.

61. An X-Y digitising system comprising:

first and second members mounted for relative movement in the X-Y direction;

said first member comprising a first magnetic field generator for generating a magnetic field substantially in a first direction and a second magnetic field generator for generating a magnetic field substantially in a second direction different from said first direction;

said second member comprising two sets of periodic windings, each set comprising first and second periodic windings, which extend along the measuring path and which are inductively coupled to said first and second magnetic field generators, the period of said first winding being different to the period of said second winding, as a result of which, in response to a magnetic field generated by each of said magnetic field generators, a first signal is generated in said first circuit and a second different signal is generated in said second circuit, the first and second signals both varying in dependence upon the relative position and orientation of the two moveable members;

means for processing said first and second signals from each of said magnetic field generators to provide a first value which depends upon said relative position and orientation and a second different value which depends upon said relative position and orientation; and

means for combining said first and second values to determine said relative X-Y position and to determine said relative orientation in dependence upon a relationship between the two periods of said windings.

62. Processing circuitry for processing signals obtained from a position detector, the processing circuitry comprising all the technical features of the processing circuitry used in the position detector of claim 1.

63. An X-Y digitising tablet comprising a first group of windings for determining the position of a moveable member relative to said digitising tablet in a first direction and a second group of windings for determining the position of said member relative to said tablet in a second direction,

wherein each of said windings comprises a conductor which extends along the corresponding measurement direction and which has a sensitivity to a magnetic field having a predetermined spatial frequency; and

wherein each winding comprises at least two loops arranged in succession along said measuring path, each loop extending along said path and said loops being connected in series and being arranged so that EMFs induced in adjacent said loops by a common background alternating magnetic field oppose each other.

64. A personal computer comprising a position detector according to any preceding claim, wherein said second member comprising said conductors and said receive

circuits are located behind a display of said computer and wherein said first member comprises a pointing device for pointing to positions on said display, and wherein the relative position of said stylus and said display determined from said position detector are used to control information which is displayed on said display.

65. A position detector comprising first and second members mounted for relative movement along a measuring path;

said first member comprising a plurality of conductors each extending in a geometrically varying manner having a different characteristic dimension along the measuring path;

said second member comprising means for interacting with said conductors, such that in response to an input driving signal applied to one of said conductors, there is induced in the other said conductors an output signal, said interacting means and said geometrically varying conductors being arranged so that said output signal varies as a function of the relative position between said first and second members along said path; and

means for processing said signal to derive said relative position.

66. A method of detecting the relative position and orientation between first and second members mounted for relative movement along a measuring path, the method comprising the steps of:

providing a magnetic field generator for generating a magnetic field on said first member;

providing first and second conductors which are inductively coupled to said magnetic field generator or said second member, the first conductor extending in a geometrically varying manner having a first

characteristic dimension along the measuring path and the second conductor extending in a geometrically varying manner having a second different characteristic dimension along the measuring path, as a result of which, in response to a magnetic field generated by said magnetic field generator, a first signal is generated in a first receive circuit which first signal varies in dependence upon the relative position and orientation of the first conductor and the magnetic field generator and a second different signal is generated in a second receive circuit which second signal varies in dependence upon the relative position and orientation of the second conductor and the magnetic field generator;

generating a magnetic field using said magnetic field generator;

receiving the first and second signals from said receive circuits; and

processing said first and second signals to determine the relative position and orientation of the two movable members using a relationship between the respective characteristic dimension of the geometrical variation of said two conductors.

67. A position detector comprising:

first and second members mounted for relative movement;

said first member comprising a magnetic field generator for generating a magnetic field;

said second member comprising first and second groups of circuits for sensing the relative position and tilt of the first and second members in two different directions;

wherein each group of circuits comprises at least two windings which are inductively coupled to said magnetic field generator and wherein the magnetic

coupling between the at least two windings varies with different spatial frequencies; and

means for determining the relative rotation between the first and second members using the sensed tilt in the first and second directions.

68. A position sensor having two sets of windings each set extending in different directions and each comprising at least two windings magnetically coupled to a magnetic field generator, and wherein the magnetic coupling between the magnetic field generator and at least two of the windings in each set varies with different spatial frequencies, and means for processing signals induced in receive circuits as a result of the generation of a magnetic field by the magnetic field generator in order to determine the relative position and orientation of the magnetic field generator and the sets of windings using said spatial frequencies.

69. A position sensor according to claim 68, wherein said magnetic field generator comprises a resonator or a combination of resonators.

70. A position sensor according to claim 68, wherein a plurality of magnetic field generators are provided which are moveable relative to said sets of windings, and each producing an identifiable signal so as to allow the relative position and orientation of each magnetic field generator and the sets of windings to be determined from the signals induced in said receive circuits.

71. A position sensor according to claim 68, wherein said means for processing said receive signals is arranged to determine the gap between the magnetic field generator and the sets of windings.

72. A position sensor according to claim 68, wherein said magnetic field generator generates two magnetic fields in two different directions, and wherein said processing means is operable to derive three degrees of freedom of the relative orientation of said magnetic field generator and said sets of windings.

73. A board game comprising a plurality of playing pieces each moveable over a playing surface and a position sensor according to claim 70 for sensing the relative position and orientation of the playing pieces and playing surface.